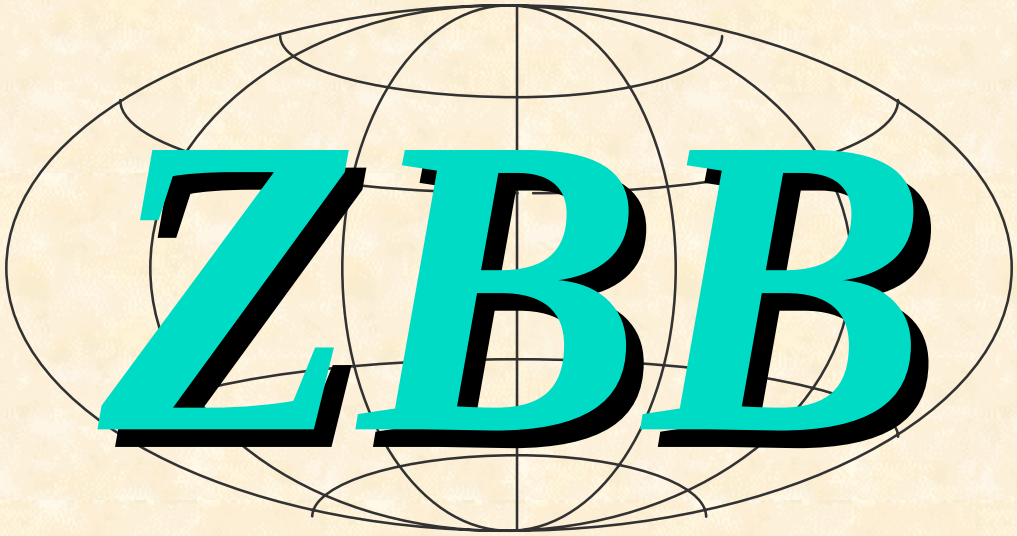


A 400 kWh Advanced Battery Energy Storage System (ABESS) for Utility Applications

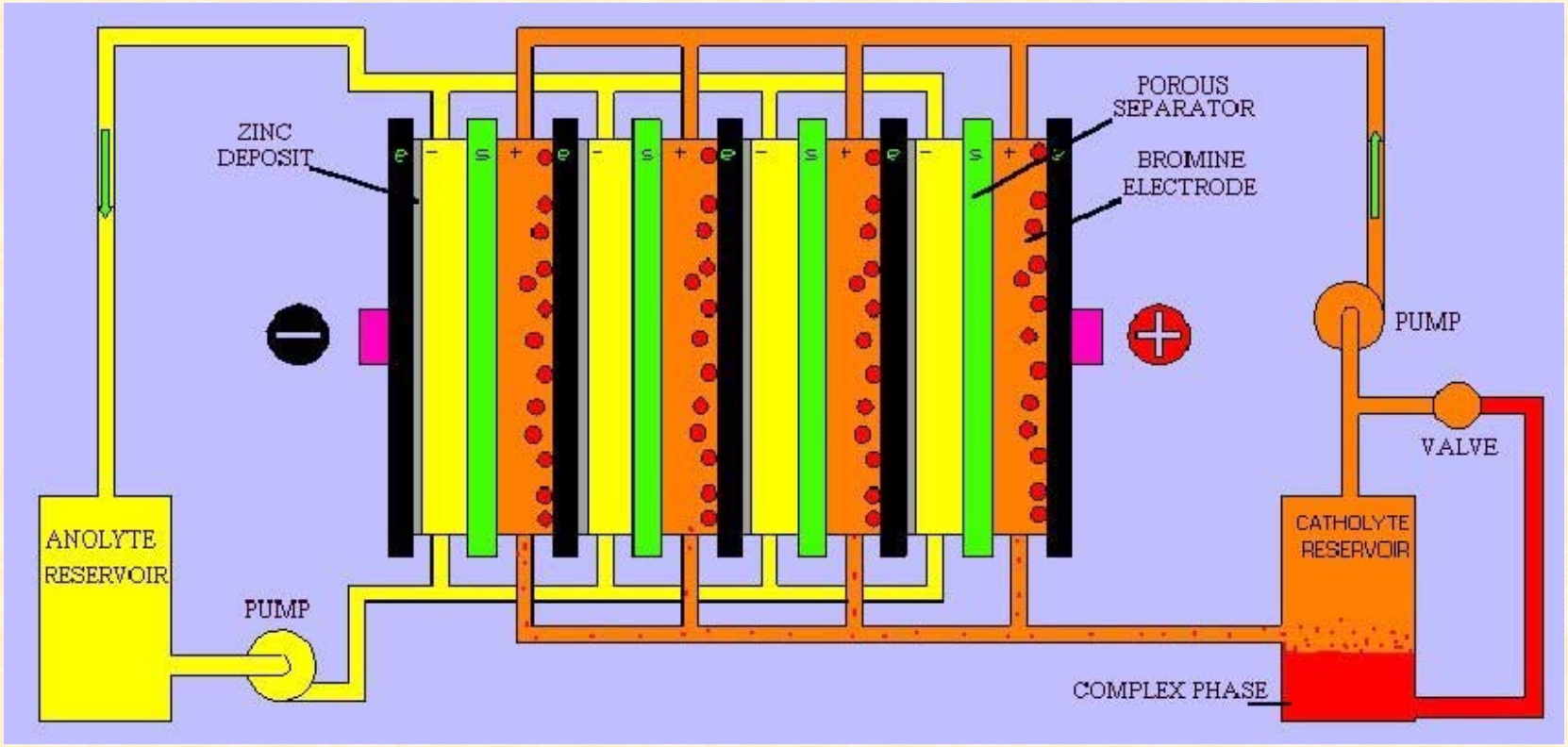
Project Contributors

- US DOE Office of Power Technologies
  - Energy Storage Program (Funding)
- Sandia National Laboratories
  - Cost shared contract
- The Detroit Edison Company
  - Test sites, transformer, data collection
- SatCon Power Systems Canada, Ltd.
  - Power conversion system
- ZBB Energy Corporation
  - Battery system

Goals of Program

- To manufacture a 400 kWh Zinc/Bromine ABESS. (DOE support since 1979).
- To test battery system at two utility sites.
  - Site 1 (Fall 2000) - Power quality, peak shaving
    Akron, Michigan.
  - Site 2 (Summer-Fall 2001) - Peak shaving,
    Lum, Michigan.

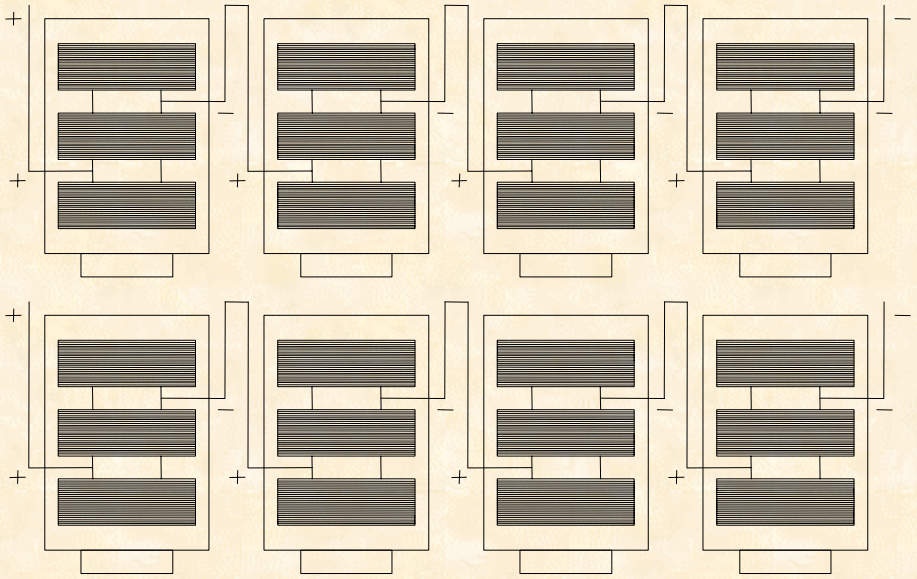
Zinc/Bromine Technology



50 kWh Battery Module

- 50 kWh (150 A, 30°C)
- 120 to 0 V DC
- 0 to 300 amps discharge
- 2 to 10 hour discharge
- 8’ x 3’ x 3’
- Approx. 3,000 lbs.

400 kWh Zinc/Bromine Battery Configuration



String 1	**Module**
432 V O/C	108 V O/C
150 amp nom.	150 amp nom.
300 amp cont.	300 amp cont.

String 2	**Total**
432 V O/C	432 V O/C
150 amp nom.	300 amp nom.
300 amp cont.	600 amp cont.

400 kWh ABESS Characteristics

- 400 kWh Capacity
- Two independent strings
- 480 to 0 V DC
- 0 to 300 amp discharge per string
- 2 to 10 hour discharge
- 20’ x 8’ x 9’6”
- Approx. 40,000 lbs.

SatCon PCS Characteristics

- 200kW/250kVA
- Grid connected or stand alone
- 480/400V AC, 3 phase
- 50 or 60 Hz
- Full four quadrant power control

ABESS Transportation

- Move out of ZBB facility
- Lift onto lowboy trailer using crane
- Assemble Parts on trailer at DE Warren Service Center
- Transport to site
- Install ventilation fans on site
- Insert upper battery modules on site
- Add electrolyte to modules on site

ABESS Transportation

ABESS Transportation

ABESS Transportation

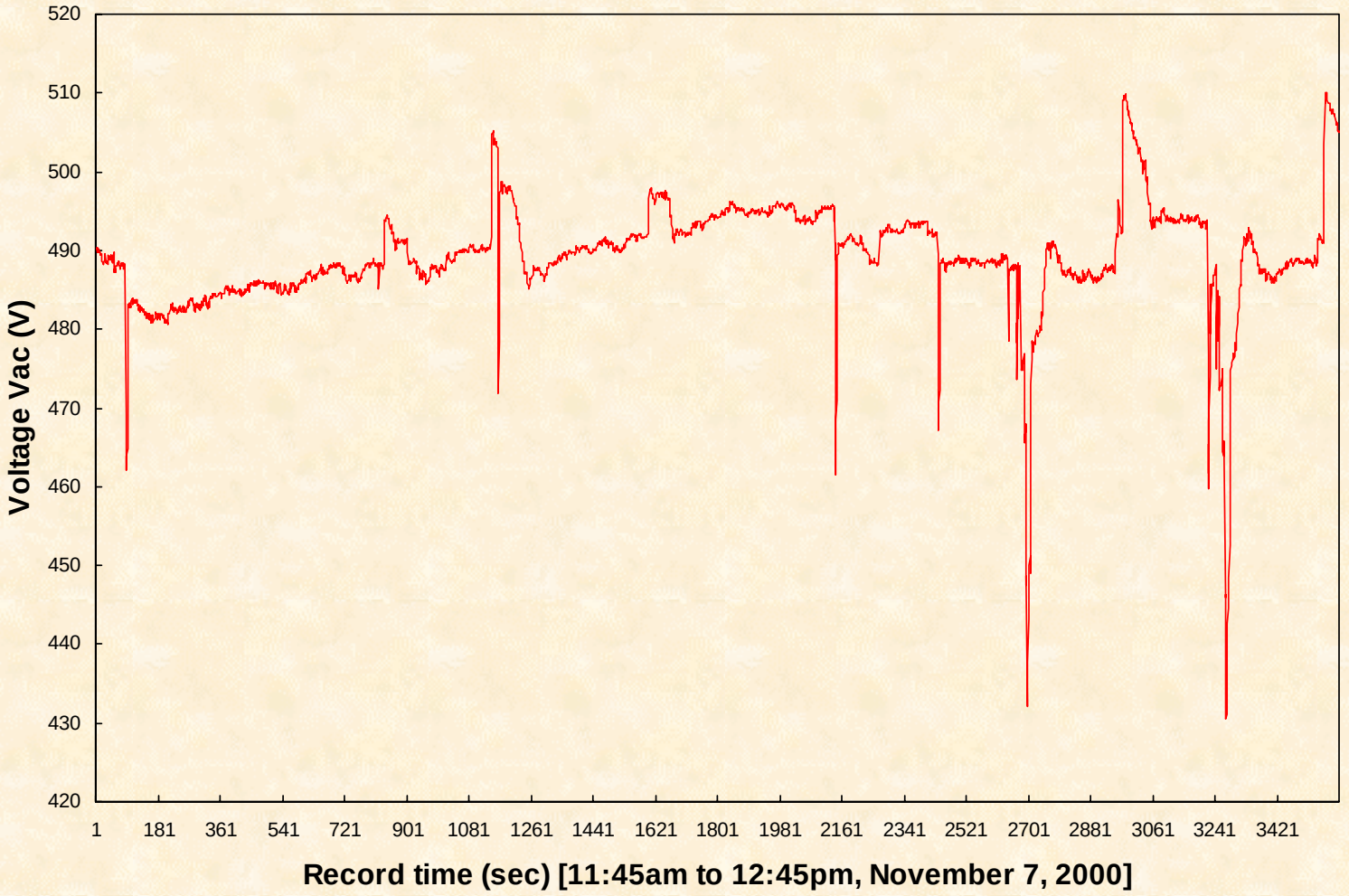
Detroit Edison
Akron Site Description

- Grain drying facility in Akron, Michigan.
- Primarily power quality application
- Season runs from mid-October to December.
- Eight 75 HP motors cause power quality sag issues for other customers on grid.
- 4-6 disturbances per day, plus a number of small events due to conveyor.

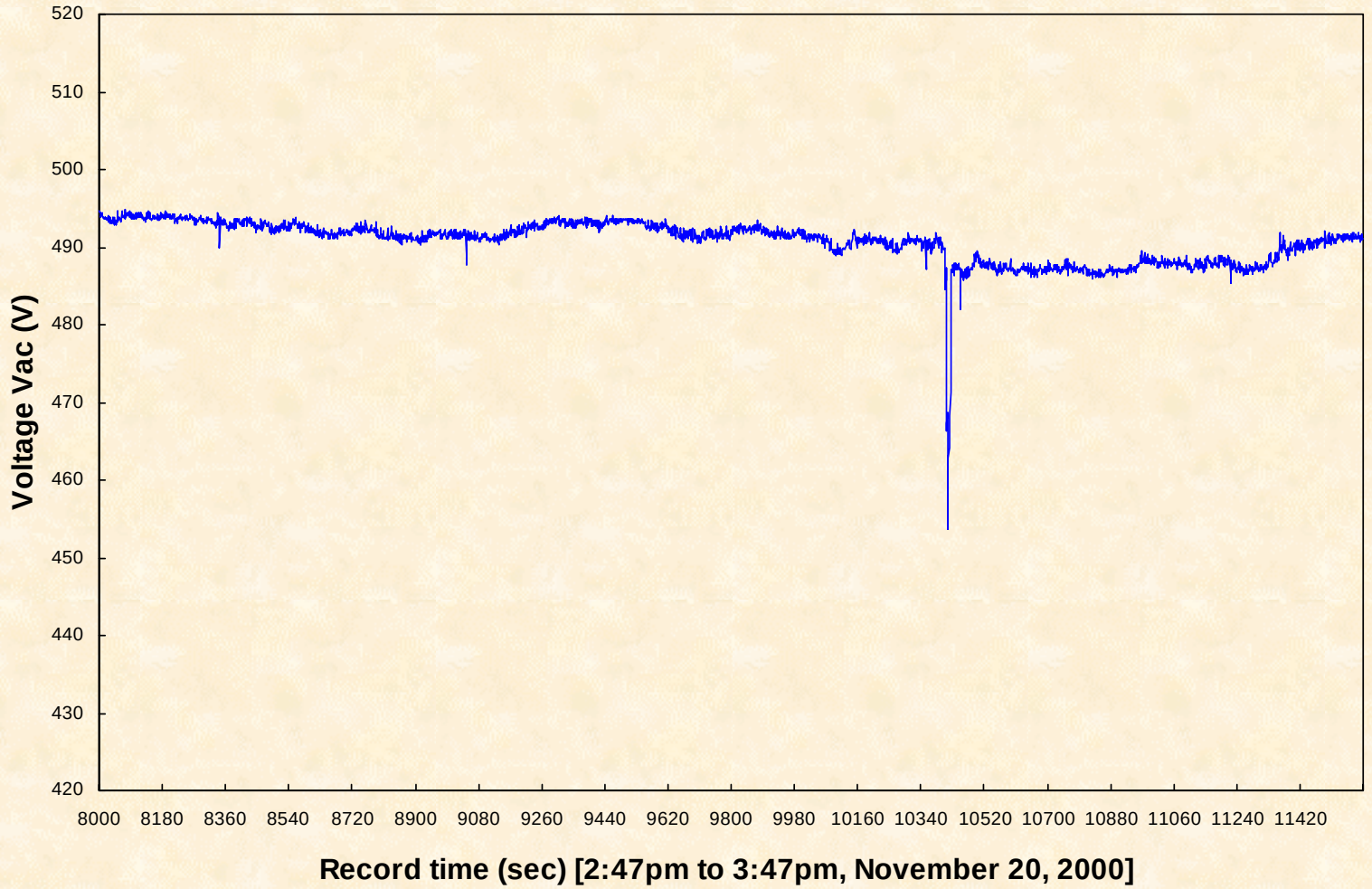
Akron Grain Drying Facility

Akron Grain Drying Facility

Line Voltage With No Compensation



Line Voltage With Compensation



Akron Site Results

- Grain dryer causes 850 kVA spike.
  - Spike was higher than expected.
  - ABESS reduced voltage drop on line.
- Voltage overshoot when dryer turned off.
  - ABESS eliminated voltage overshoot.

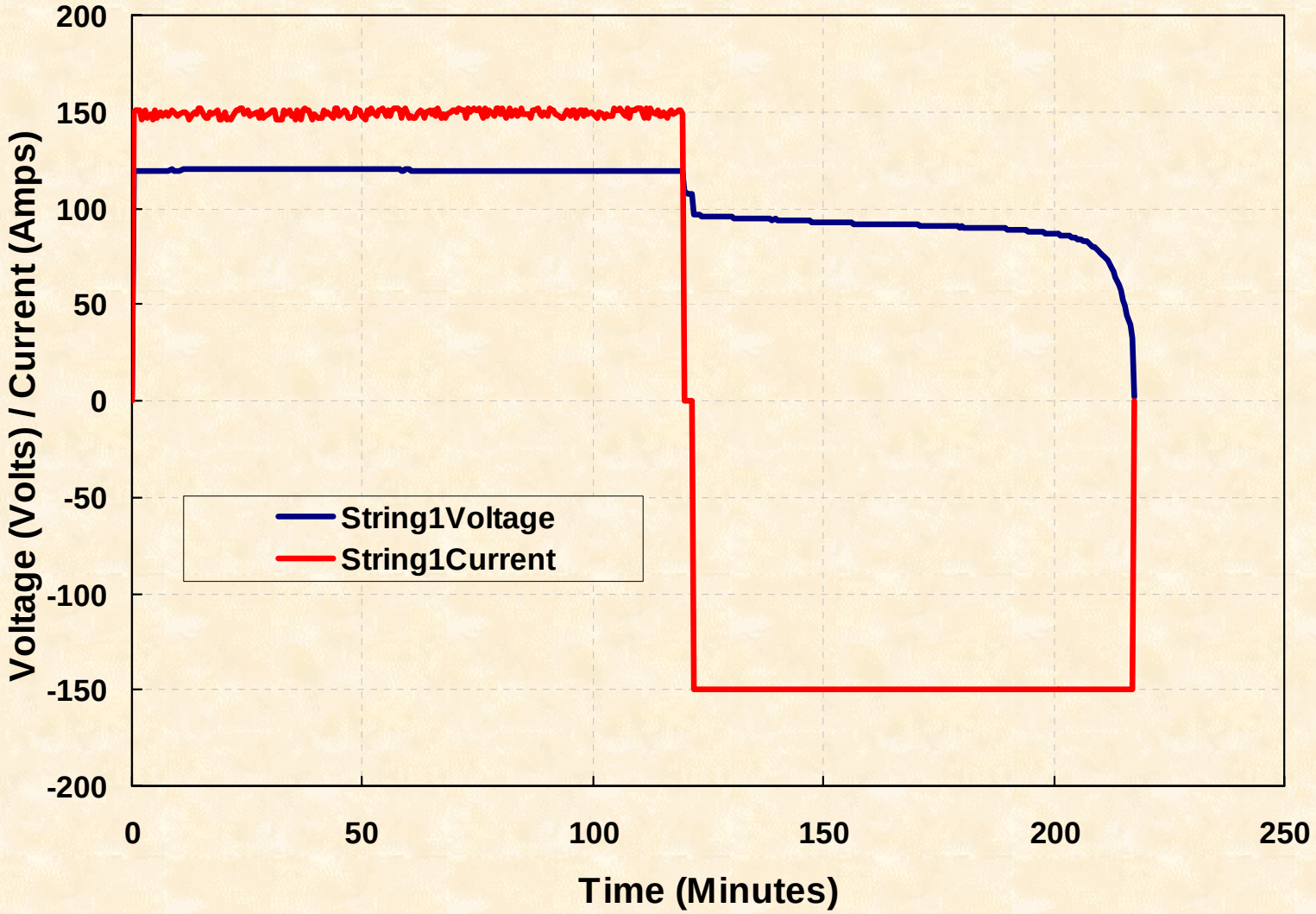
Detroit Edison
Lum Site Description

- Peak shaving application
- 800 kVA Transformer near capacity
- Load expected to exceed transformer rating due to summer peaking.

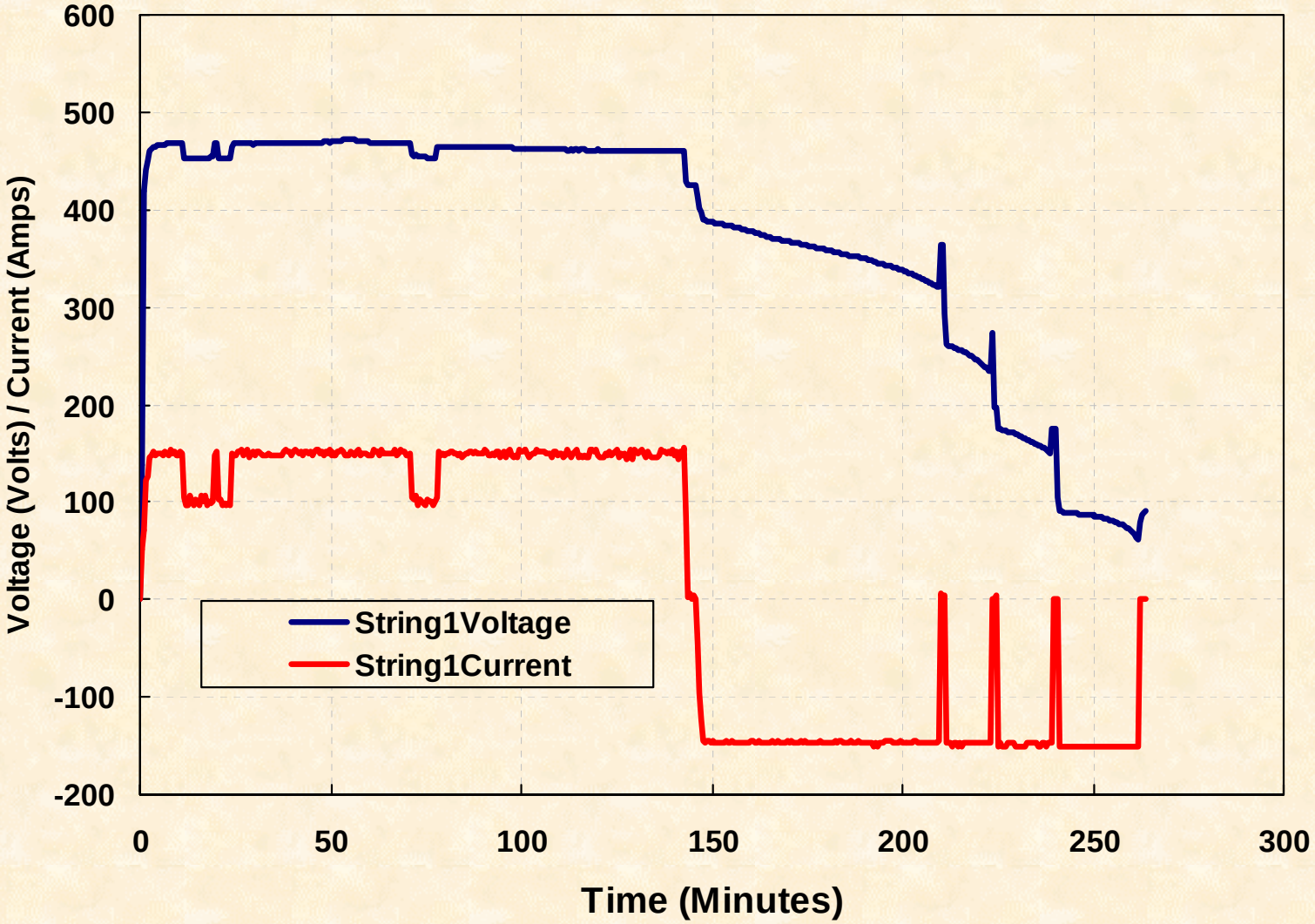
Lum Peak Shaving Site

400 kWh ABESS at Lum Site

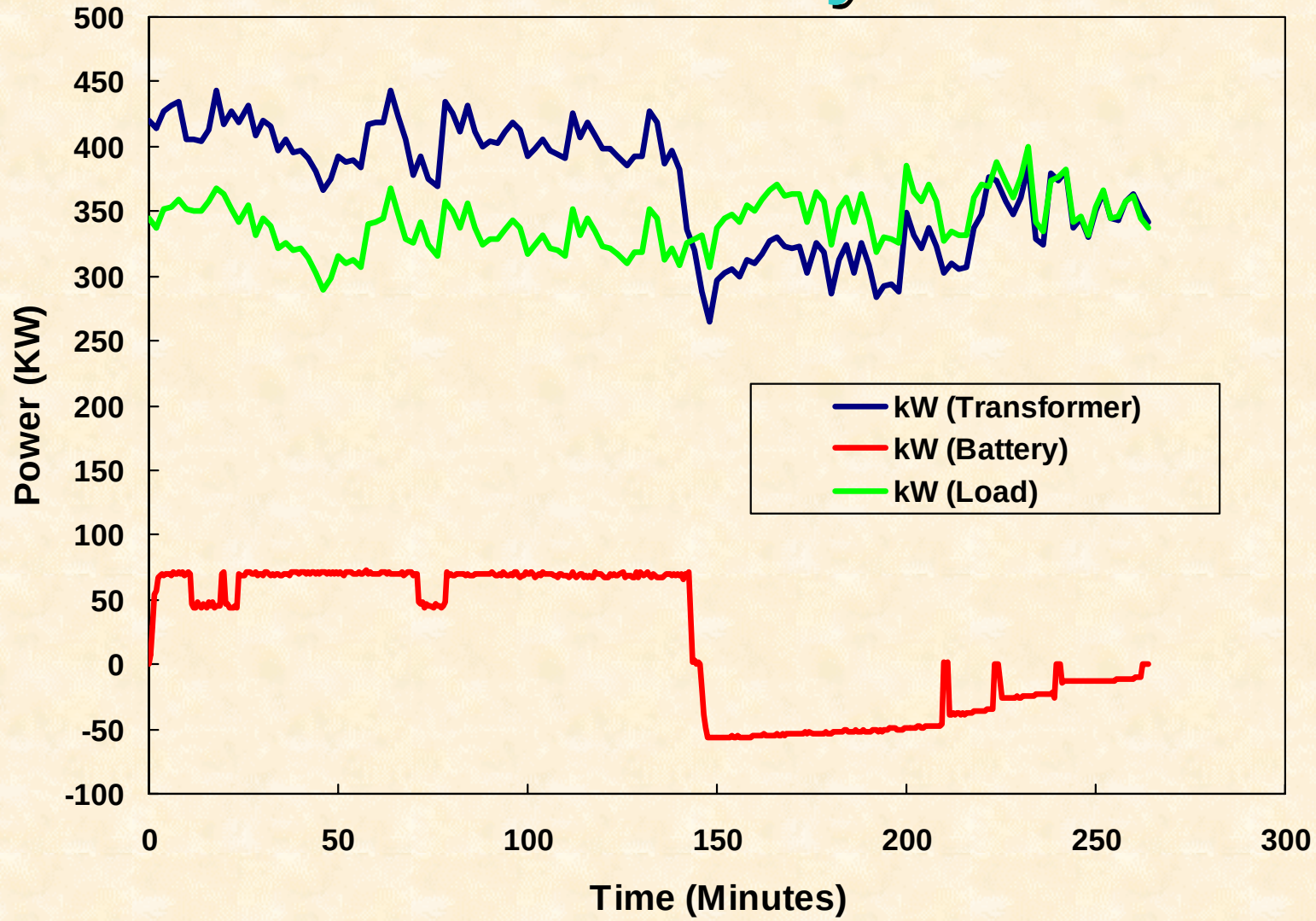
Voltage Profile for 50 kWh Module



Voltage Profile for 200 kWh String



Load on Utility Line



Lum Site Test Results

- Interconnection issues resolved on-site
- SatCon and ZBB software issues worked out on site
- Successful interface between utility, PCS and battery
- Data analysis in progress

Lessons Learned from Program

- Need for data collection prior to sizing ABESS. (Knowledge of voltage sags/surges prior to installation.)
- Transportation could have been performed in one step with a “Low-boy” trailer.
- Software and noise issues could not be addressed until ABESS on site.

400 kWh ABESS Summary

- Successfully demonstrated at two DE sites.
- Akron Site Summary (Power Quality)
  - Reduced the line voltage drop associated with start-up of the grain dryer to under 5%.
  - Eliminated overvoltage observed during grain dryer shut-down.
- Lum Site Summary (Peak Shaving)
  - Demonstrated capability to automatically control ABESS for Peak Shaving application.
  - Invited back for testing next summer by Detroit Edison (Negotiations underway).